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United States  
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Cooperative State  
Research Service

November 1981

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# Animal Health Science Research Advisory Board

## 1980 Annual Report

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ANIMAL HEALTH SCIENCE RESEARCH ADVISORY BOARD

--1980 ANNUAL REPORT

Cooperative State Research Service  
U.S. Department of Agriculture

November 1981

ANIMAL HEALTH SCIENCE RESEARCH ADVISORY BOARD

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## EXECUTIVE SUMMARY

Nationwide concern over the \$12 billion annual health loss of food animals has led to enactment of authorizing legislation (Subtitle E, Public Law 95-113) and appropriations (Section 1414 (c)(1) and Section 1433 of Public Law 95-113) for Federal support of new extramural programs for animal health and disease research. In Fiscal Year (FY) 1979, \$15 million was appropriated for this research, \$13 million in 1980, and \$11.55 million in 1981. The Cooperative State Research Service administers these programs. The Animal Health Science Research Advisory Board, established by the authorizing legislation, has provided consultation and advice to the Secretary that has been essential in implementing this research.

New research was initiated in colleges of veterinary medicine, State agricultural experiment stations, and other cooperating institutions in FY 1979 through 424 research projects that seek solutions to high-priority food animal and equine health problems. Much of this research is continuing, and additional new work has been implemented under funding for FY's 1980 and 1981.

Two years of research under these projects now have been completed (FY's 1979 and 1980). This publication report summarizes some of the progress made and its significance in solving animal health and disease problems.

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ANIMAL HEALTH SCIENCE  
RESEARCH ADVISORY BOARD  
1980 Annual Report

Current Concerns in Animal Health

A major risk for producers of food animals is the possibility of substantial loss of animals from diseases, parasites, or other causes. From 15 to 20 percent of food animals die before reaching market. These losses, in addition costs for treatments and growth inefficiencies in animals that recover from illnesses, result in financial loss exceeding \$12 billion annually.

Since modern production practices require large numbers of animals in closely confined conditions, risks of disease are greatly enhanced. Increased concern over the environment and product safety has reduced livestock management alternatives, for example, in disposing of waste or in using feed additives in disease prevention. The potential hazards of animal drugs and pesticides need to be clarified. Practical, effective measures sometimes are limited or lacking for serious livestock and poultry health problems. Alternate methods of control need to be developed. Disease agents are changing continually, and new agents are encountered frequently. There is current, widespread concern over pseudorabies in swine and brucellosis in cattle, Exotic Newcastle disease (VVND) in poultry, and bluetongue in sheep and cattle. Foreign animal diseases pose a greatly increased hazard for international air transportation of people, animals and animal products. In 1977 contagious equine metritis was found in the United States for the first time. During this same year, the dreaded swine disease, African swine fever, crossed the Atlantic Ocean to appear and spread in Brazil, the Dominican Republic, and Haiti, and in 1980 it occurred in Cuba. In 1981, foot-and-mouth disease was identified once again in Great Britain.

From an overall viewpoint, diseases reduce efficiency in the production of food animals. Although livestock producers individually must initially absorb disease losses, collectively the anticipated level of losses is passed on to the consumer as a cost of producing animal products. In the Nation's long-term outlook, these losses will have even greater critical importance in terms of wasted energy resources (feed and other energy requiring production inputs) and in limiting capacity to meet expanding national and international population requirements for high-quality protein.

Future Research Concerns in Animal Health

In 1980, a conference on animal agriculture was held at Boyne Mountain, Michigan, to identify priorities for future research to enable animal agriculture to efficiently and effectively serve human needs in the 21st. century. The conference was organized into 10 working groups to address the critical challenges facing animal agriculture as follows: human nutrition, food processing and acceptability; food safety; animal nutrition; animal genetics and reproduction; animal health; feed production; production, marketing, and distribution; resources and environment; and public policy. The animal health group developed four broad research imperatives:

(1) Integrated food animal health systems--Develop integrated (inter-disciplinary multifactorial) methods to identify and quantify factors and interactions responsible for losses and inefficiencies in the production environment, and develop analytic systems to construct practical strategies for the control of production diseases. Examine under controlled conditions causative interactions to substantiate on-the-farm assessment of control strategies and construct computer simulation models to evaluate alternative control strategies. Develop a national system of animal disease reporting, animal identification and standardization of diagnostic methods and systems.

(2) Genetic engineering for disease resistance and immunity--Identify and enhance disease resistance in animals. Apply recombinant DNA techniques to infectious agents and characterize the means by which animals develop protective immunity. Devise techniques to accelerate protective immunity in the newborn and devise strategies to produce maximum protection against disease. Special attention should be directed to the importance of developing effective technology for control of the most destructive foreign animal diseases.

(3) Hazards to food animals from chemical agents--Develop rapid economical procedures for quantitative identification of a broad spectrum of chemicals (contaminants, naturally occurring toxins, and drugs) and their metabolites in animal tissues and feeds for use in the diagnosis and monitoring of animal contamination. Define cellular mechanisms of drug and chemical actions and interactions, including how they are affected by stress and disease. Develop new pharmaceuticals and pesticides that are innately less dangerous through fundamental research taking into account mechanisms of drug action that bypass animal and human biological mechanisms.

(4) Elimination of human health hazards--Develop procedures to eliminate animal pathogens from food animals, animal products, and the environment of human beings. Eliminate potentially toxic chemicals and their metabolites from food products. Develop antimicrobial agents, growth promotants and permissants and production improvers that do not have the potential for adversely affecting human health through transfer of resistance factors.

#### The Food and Agricultural Act of 1977

This Act (Public Law 95-113) recognized the national concern for the health and diseases of food animals and authorized new research programs for the control of these problems in livestock, poultry, and aquaculture species. The U.S. Department of Agriculture FY 1979 Appropriation Act provided funds to activate provisions of Public Law 95-113 covering animal health and disease research. Under Section 1433, a total of \$5 million was appropriated for formula distribution, and under Section 1414 (c)(1) \$10 million for animal health research grants. In FY 1980, Section 1433 funding was continued at the level of \$6 million and Section 1414 (c)(1) funding, at a level of \$7 million. In FY 1981, Section 1433 funding was \$6.5 million, and Section 1414 (c)(1) funding \$5.05 million.

TABLE 1

ITEM	FY 1979	FY 1980	FY 1981
	<u>Thousand dollars</u>		
Formula Funds Section 1433	5,000	6,000	6,500
Special Research Grants Section 1414 (c)(1)	10,000	7,000	5,050

Section 1433 (Animal Health and Disease Formula Program)

Under the Section 1433 formula program, the Department has been able to strengthen its animal health research partnership with the State agricultural experiment stations and to extend this partnership to all colleges of veterinary medicine. Provisions of Section 1433 are unique in that funds are distributed to the States in relation to a State's livestock importance and its capacity to conduct animal health and disease research. When more than one eligible institution exists within a State, the State's entitlement is distributed to these institutions in accordance with their animal health research capacities. State contribution to expanded animal health research is encouraged through a requirement that each State match any Section 1433 funds received annually in excess of \$100,000.

Because of the delay of up to 4 months in the final approval of the USDA budget for FY's 1979, 1980, and 1981, the research projects conducted in these years had to be delayed at the beginning of each fiscal year until funding was certain. When funds became available and new plans of work were submitted to Cooperative State Research Service (CSRS) by the eligible institutions, the research projects were resumed, if continuous, or started, if new. Unfortunately, however, this delay disrupted the research activities and sometimes resulted in dismissal of both staff scientists and technicians.

Section 1414 (c)(1) Special Grants for Animal Health

As discussed in the 1978 annual report of the Animal Health Science Research Advisory Board, \$505,762 of FY 1979 funds under this section were made available to 17 States as supplemental special research grants to permit initiation of viable programs in animal health research.

In FY 1979, \$8,951,744 of Section 1414 (c)(1) funds were committed to animal health research in a competitive process. Of research proposals covering more than \$110 million of proposed research, 659 were evaluated by scientists in three panels--infectious diseases, internal and external parasites, and noninfectious diseases. A list of the 75 projects funded as a result of panel recommendations is given in the 1979 annual report of the Animal Health Science Research Advisory Board.

In FY 1980, \$6,790,000 of Section 1414 (c)(1) funds were committed to animal health research in a competitive process in which a total of 352 proposals requested over \$44 million. A list of the 70 projects funded as a result of panel recommendations is in USDA's Miscellaneous Publication No. 1369.

As recommended by the Animal Health Science Research Advisory Board, placement of these grants considered factors such as scientific merit, priority of the problem to be studied, and distribution of funds among the animal commodities in relation to their importance. The resulting distribution to be made to these funds by commodity and within commodities in FY 1981 follows.

<u>Beef Cattle</u> (44 percent)	<u>Percent Within Commodity</u>
1. Respiratory disease complex-----	40%
2. Reproductive diseases, especially brucellosis and including but not limited to anestrus, leptospirosis and vibriosis.	30%
3. Enteric diseases-----	20%
4. Parasites (internal and external), including but not limited to anaplasmosis, blue tongue, fever tick, flukes, and scabies. Metabolic diseases, especially bloat, grass tetany, and mineral imbalance. Diseases of the central nervous system, foot rot, pink eye, sudden death syndrome, toxic substances, and weak calf syndrome.	10%
<u>Dairy Cattle</u> (23 percent)	
1. Mastitis-----	35%
2. Reproductive diseases, especially brucellosis and including anestrus.	30%
3. Respiratory diseases-----	20%
4. Digestive and enteric diseases-----	15%
<u>Swine</u> (13 percent)	
1. Enteric diseases, especially in young animals-----	30%
2. Respiratory diseases, especially causative agents, and including but not limited to atrophic rhinitis.	30%
3. Parasites (internal and external), especially trichinosis, and including but not limited to mange mites and lice.	25%
4. Lameness, especially in breeding animals-----	15%



<u>Poultry</u> (12 percent)	Percent Within Commodity
1. Respiratory diseases-----	40%
2. Skeletal problems such as femoral head necroses, teno-synovitis, and tibial dyschondroplasia.	30%
3. Enteric disorders including coccidiosis, salmonellosis, clostridial infections, and malabsorption syndrome.	20%
4. Neoplastic diseases including Marek's diseases, lymphoid leukosis, and reticuloendotheliosis.	10%
<u>Sheep and Goats</u> (4 percent)	
1. Predators-----	No recommendation
2. Respiratory diseases, especially chronic progressive pneumonia.	" "
3. Enteric diseases including parasites.-----	" "
4. Blue tongue-----	" "
<u>Horses</u> (3 percent)	
1. Respiratory diseases-----	No recommendation
2. Enteric diseases-----	" "
3. Reproductive diseases-----	" "
4. Musculoskeletal diseases, especially laminitis and lameness.	" "
<u>Aquaculture</u> (1 percent)	
1. Diseases and parasites-----	No recommendation

#### Selected Examples of Recent Progress in Animal Health Research

Examples of progress were selected from approximately 475 reports submitted by the investigators of projects that received support from Section 1433 and Section 1414 funding in FY's 1979 and 1980. The research work on many of these projects has not been completed. Examples were selected from animal health and disease research projects involving cattle, swine, poultry, sheep and goats, horses, and aquaculture.

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## Cattle

### General

#### Improved Method for Diagnosing Livestock Diseases

California, Colorado, Pennsylvania, and South Dakota are studying the ELISA test, which involves a new principle for virus disease diagnosis. This test will be of special value as a rapid and comparatively easy method for diagnosing many important virus diseases. An additional benefit is that the ELISA test does not require the radioactive materials necessary for another commonly used viral diagnostic test. This test should provide the tool needed by veterinary laboratories for low-cost, rapid, and highly accurate diagnosis of livestock disease outbreaks. Numerous viruses cause serious disease losses in livestock production. Identification of a virus suspected of causing a disease outbreak currently requires tedious and time-consuming laboratory procedures. Accurate identification is essential in implementing effective measures for disease control.

#### Identification of Disease-Resistant Cattle and Chickens

Scientists in California, New York, Ohio, and Wisconsin have initiated basic studies to identify cattle and chickens having superior genetic resistance to specific diseases. These scientists are examining specific segments of cell chromosomes from these animals to find genetic markers that will permit accurate identification of individual animals that are highly resistant to certain diseases. The chromosome segments under study control specific kinds and amounts of disease-fighting cells or protective substances that each animal mobilizes to counter disease agents. Success in this research will permit selection and breeding of animals highly resistant to disease agents and will provide an effective means of reducing the estimated \$12 billion annual loss that results from illness and death of livestock and poultry.

### Bovine Leukosis

Scientists at Auburn University, investigating the transmission of bovine leukosis virus (BLV) (etiological agent of lymphosarcoma in cattle), have shown that the genital tract of cows in estrus is relatively resistant to BLV infection. Since BLV-contaminated semen was inoculated into 15 sero-negative cows and did not produce infection, it is probably not an important means of transmitting bovine leukosis. Other evidence suggests that certain insects may play a role in the transmission of BLV and may be a potential reservoir for it. Tissues from infected mosquitoes injected into cattle caused sero conversion to BLV. Preliminary findings tend to indicate that T-lymphocytes may be the predominant leucocyte population altered in BLV infected cattle. Contrary to currently held suppositions, these data may cause scientists to reevaluate the pathogenesis of BLV infection in cattle. Since bovine leukosis is a widespread infection in both dairy and beef cattle, some foreign countries have placed important restrictions on cattle from the U.S.



## Beef Cattle

### Respiratory Disease Complex

Immune Mechanisms Associated with Shipping Fever.--Scientists at Kansas State University are studying shipping fever of cattle, particularly the immunity of the animal to a bacterium found in respiratory infections. *Pasteurella*-specific immunoglobulins in serum and in nasal and lung washings have been assayed from rabbits immunized with endotoxins of *Pasteurella multocida*. Preliminary results indicate that IgM is the principle immunoglobulin and little, if any, specific IgG could be demonstrated. Basic studies are needed to elucidate the immune mechanism associated with *pasteurella* infections, which ultimately will improve immunizing agents and prevent losses from shipping fever.

Shipping Fever: Impact on Cattle, Production and Potential Control by Interferon as an Antiviral Drug.--A recent survey estimated that respiratory diseases (shipping fever) represented the major economic problem to Louisiana cattle producers. Infectious agents included the interaction of viruses, bacteria causing pasteurellosis, and mycoplasmas. Interferon, a protein acclaimed as a potential cancer virus fighter, protected cattle against respiratory tract virus in laboratory tests conducted by scientists at Louisiana State University. Interferon now seems to be able to protect cattle against several diseases for which no effective vaccines exist. Researchers in the School of Veterinary Medicine have been developing techniques to effectively identify mycoplasmas, a group of agents that seem to have a greater role in shipping fever than had been anticipated. If interferon proves effective against these agents, the economic gain could be significant among cattle producers.

Studies are Initiated on Parainfluenza-3 and Respiratory Syncytial Viruses. Scientists at the University of Maryland have initiated a basic study on the resistance of cattle to parainfluenza-3 (PI-3) and respiratory syncytial (RS) viruses. The objectives of this study are (1) to evaluate the development and protective effects of immunity in experimentally infected cattle, (2) to determine if enhancement of RS virus infection occurs in the presence of serum antibodies, and (3) to determine whether a drug (2-deoxy-D-glucose) has any protective effect against RS infection.

This study will enhance the understanding of respiratory disease complex in cattle and lead to the development of methods for preventing and controlling this costly problem.

Calf Pneumonia - Role of Respiratory Syncytial (RS) Virus Under Study.--Oregon State University researchers are trying to determine if the respiratory syncytial virus (RS) has any part in producing calf pneumonia and enzootic pneumonia. These researchers developed a reliable, quantitative test for detecting antibodies to this disease. They were able to infect calves with the RS virus, which produced a mild disease. Respiratory infection in calves and cattle is a complex problem involving two agents or more. Studies are continuing to determine the role of RS virus in initiating disease, which may be complicated by other pathogens.

Bovine Respiratory Disease--Effect of Multiple Infections.--Research workers the College of Veterinary Medicine, University of Tennessee, have been working on the effect of bovine virus diarrhea (BVD) virus on bovine respiratory tract disease and pulmonary immunity. Bovine respiratory disease and shipping fever pneumonia continue to cause multi-million-dollar losses in feedlot cattle. Scientists at the University of Tennessee have identified a strain of BVD virus that suppresses the immune system of the young calf. They developed a model to reproduce shipping fever pneumonia that involves multiviral infections in addition to a bacterium, *P. haemolytica*. Animals having a suppressed immune system from BVD virus infection are exposed to a strain of infectious bovine rhinotracheitis (IBR) virus plus pasteurella organism. Severe respiratory distress and pneumonia develop. Studies are continuing to determine how to modulate the defense mechanism of animals and how to protect against respiratory infections.

Medication Program for Shipping Fever Evaluated.--Scientists at New Mexico State University have initiated a research project to compare health, nutrition, and management procedures for newly received cattle and their subsequent performance. Various preventive regimes for shipping fever, a common problem in transported cattle, have been investigated. The initial phase of this study indicated that administration of oxytetracycline to a group of cattle for three successive days followed by sulfadimethoxine, reduced their total sick days 82 percent compared with a nonmedicated group. This preventive medication program was more effective than the program for treating calves that became sick with shipping fever. Included also in the study will be the effects of dietary regimes on the stressed calves.

### Reproductive Diseases

Brucellosis in Reindeer Under Study.--Scientists at the University of Alaska have initiated studies on brucellosis of reindeer to determine the serological response after experimental vaccination and to ascertain the incidence of brucellosis in reindeer herds. Four types of vaccines are being studied, and various serological tests are being compared. The complement fixation (CF) test appears to be the more consistent test. Cooperative efforts with the University of Hawaii are underway in developing the ELISA test on reindeer sera. Initial results indicate that this test is both accurate and easily performed. Methods are being studied for use as a field test.

Field investigations indicated that brucellosis is increasing and that it has spread to new areas. Alaskan reindeer provide meat for local consumption and limited export to speciality markets. Reindeer ranching is one of the best Alaskan potentials for growth, and for this industry to expand, brucellosis be controlled.

Brucellosis Vaccination Trials in Progress.--Brucella immunization experiments are underway at the Idaho Agricultural Experiment Station to evaluate various types of vaccines for brucellosis. Whole bacteria in combination with compounds (adjuvants) produced vaccines that are 70 to 90 percent effective in preventing disease in laboratory animals. An extensive trial is underway in cattle to evaluate the efficacy of the vaccine. An ideal vaccine provides protection without causing the animal to become blood test positive on the routine diagnostic tests. Brucellosis has been given a high priority for increased research by the beef and dairy cattle industry.

Toxoplasmosis Studies in Cattle Initiated.--Veterinary scientists at Montana State University have initiated a basic study on the role of Toxoplasma Gondii in bovine abortions, evaluation of diagnostic tests, and significance of the infection for public health. Field observations have indicated that this organism may cause abortions and may be potentially transmitted to humans by ingesting infected beef and milk. Preliminary studies indicated the oral feeding of T. gondii to calves caused 100 mortality. Studies are now underway using pregnant cows from a closed herd that has been monitored closely for several diseases associated with abortions. In a recent study in Montana, 62 percent of dairy cattle had antibodies to the infection and only 27 to 35 percent of the beef were seropositive. This study will provide information on the pathogenesis and transmission of toxoplasmosis in cattle and will help regulatory agencies concerned with the persistence of Toxoplasma in meat and milk for human consumption.

Toxicity of Moldy Hay - A Cause of Abortion in Cattle.--Scientists at the University of Idaho's Department of Veterinary Medicine have isolated a highly toxic compound from moldy hay that may cause abortion in cattle. Two molds, Aspergillus flavus and Aspergillus ochraceus, have been found in moldy hay samples sent in by farmers in Idaho and Washington.

Scientists are attempting to identify the chemical structure of the toxin and to develop methods to control mycotoxin production in hay that will have a great impact on the livestock industry.

#### Enteric Diseases

Studies to Clarify Enteric Infections in Calves.--Veterinary scientists at the University of Nebraska have initiated a study on infectious enteric diseases of young calves, particularly single and combined infections in germ-free animals. Field outbreaks of enteric infections usually involve more than one agent, and assessing the effects of infectious agents in conventionally raised animals sometimes is difficult. Researchers at the University of Nebraska have developed techniques to study enteric infections in germ-free animals and specific pathogen-free animals. Studies were done by using two types of E. coli (K99(+)) and K99(-) strains in germ-free calves. These E. coli strains were used alone and in combination with rotavirus, which is associated with a viral enteric infection. The K99(-) strain had no effect as compared with K99(+), which was highly pathogenic. The combination of K99(+) and rotavirus produced severe enteritis, which led to rapid death.

A better understanding of the pathogenesis of enteric infections will help develop procedures to prevent or reduce the mortality/morbidity of specific and complicated infectious diseases of calves.

Bovine Coronavirus--New Tissue Culture Procedure Developed.--Scientists at South Dakota State University have developed a tissue culture system that could enhance the isolation rate of neonatal calf diarrhea virus (coronavirus) from field material and could facilitate investigations on the relationship of this virus with bovine respiratory cells. Bovine coronavirus has been difficult to isolate in tissue culture systems, and its diagnostic procedures have relied on the use of electron microscopy.



The addition of trypsin to bovine embryonic cells in serum-free medium allows the virus to replicate and produce cytopathic changes. Studies are continuing and may be applicable to other coronaviruses in poultry, swine, and other animals. Coronaviruses commonly are associated with respiratory and enteric infections and cost the livestock and poultry industries hundreds of millions of dollars in loss each year.

## Other Diseases

### Anaplasmosis

Purification of Vaccine for Anaplasma Marginale Developed.--Scientists at Louisiana's Agricultural Experiment Station have separated successfully Anaplasma marginale from host erythrocytic components. This method may provide the basis for developing a safe vaccine for anaplasmosis in cattle and may eliminate problems associated with previous vaccines. Anaplasmosis is a disease of cattle that causes losses valued in the millions of dollars for U.S. cattlemen.

Anaplasmosis - Transmission Studies with Flies.--Veterinarians at Mississippi State University have initiated an extensive study on anaplasmosis to develop an in vitro (test-tube) system for cultivating the anaplasma organism and to evaluate these cultures for use as immunizing agents. Since various systems for cultivating these organisms have been unsuccessful, new approaches are being tried.

Transmission trials with horse flies indicated that immediate mechanical transmission occurred with 10 fly bites. Delayed transmission attempts indicated that the flies can remain infected for at least 2 hours after receiving a partial blood meal. Results of transmission trials are helpful in developing measures to prevent transmission between herds.

Anaplasmosis - Studies on Tick Transmission.--Scientists at the Oklahoma State University's College of Veterinary Medicine have initiated an extensive study on anaplasmosis. Objectives of this research are to identify cattle ticks capable of transmitting anaplasmosis, to determine the parasitemia level required for infectivity of immature ticks, to demonstrate organisms in tissues of infected ticks, and to isolate the organism from infected ticks.

Anaplasmosis, a serious disease in southern States, has been spread by interstate movement of infected cattle.

### Bluetongue

Bluetongue Virus Associated with Lymphocytes.--Veterinary scientists at the University of California-Davis have found (contrary to published data) that the majority of bluetongue virus (BTV) is associated in the white blood cells (lymphocytes). An extensive study was made on the distribution of BTV

in various blood cell populations and plasma. These initial studies indicate that the white blood cells are responsible for most of the virus replicating an infected animal. Results of these studies will greatly facilitate the diagnostic ability to certify cattle to be free of BTV for breeding and export. Studies are in progress in latently infected cattle to determine whether the same cells are responsible for virus persistence.

### Pinkeye

Development of Diagnostic Serological Test for Pinkeye.--Scientists at the Virginia - Maryland Regional Veterinary College have developed a serological test to detect antibodies to pinkeye infection in cattle. The ELISA test will detect IgG and IgA antibodies against the Moraxella bovis organism in blood serum and secretions of infected cattle. Research indicates that antigenic variation of Moraxella bovis isolates is common and may impede the induction adequate protection with current immunization procedures. Vaccines may be of limited or no value if animals are exposed to infecting organisms that differ antigenically from that of the vaccine. The serological test (ELISA) will permit rapid identification of antibodies and will be useful as a diagnostic tool to evaluate immunization procedures.

### Hemoglobinuria

Hemoglobinuria - Studies Underway on Bacillary Hemoglobinuria (Redwater Disease).--Scientists at the University of Nevada have initiated basic studies on the causative agent of bacillary hemoglobinuria (Redwater disease) to develop a better vaccine for preventing this disease. Redwater disease has been a continuous problem in cattle and sheep in the western part of the U.S. and other countries of the world. Current studies have evaluated media for cultivating C. haemolyticum and ability to stimulate growth and yield of toxins. A medium was found that increased growth twofold to fourfold and increased toxin activity 1.5-fold to threefold over control medium. Studies are in progress to isolate and characterize the toxins of the organisms that may be responsible for its pathogenesis. Once the toxins are identified, toxoid vaccines will be evaluated in laboratory animals, followed by field studies in cattle and sheep. A more effective vaccine will reduce the losses and provide a longer duration of immunity. The current vaccine may provide protection for about six months.

### Internal Parasites

Internal Parasites - Immune Mechanisms to Parasitic Disease Under Study.--Veterinary scientists at the University of Illinois have initiated a basic research project on the effect of parasitic diseases on the immune response of animals. Generalized immunosuppression occurs in many parasitic diseases and may render the parasitized animals incapable of mounting an effective immune response to disease agents unrelated to the parasite. Research workers have used murine malaria as a model system and have isolated and purified a soluble immunosuppressive factor from the causative agent, Plasmodium berghie. This finding opens the possibility of developing a substance that will reverse the immunosuppression and may lead to similar investigations in parasitic infections that are widespread and economically important, such as coccidiosis in livestock and poultry.

Stomach Parasites in Ruminants.--Parasitologists at Virginia - Maryland Regional Veterinary College have initiated a basic study on the development of diagnostic properties of gastric parasites (Ostertagia) that may be detectable in the blood and may reflect worm infection. Virginia Polytechnic Institute and State University has established one of two sites in the U.S. where Ostertagia are being cultured in the laboratory and where their in vitro products are being analyzed for diagnostic properties. The development of a diagnostic tool will permit efficient control of the major parasitic disease of ruminants. Products of gastric inflammation detected in the blood during abomasal infection by stomach worms also are being analyzed.

Another phase of study is directed to the development of effective immunizing systems for gastric parasites. Internal parasites of cattle and sheep cost the livestock producer millions of dollars loss each year in malabsorption of nutrients and retarded growth and expenditure of millions of dollars for antiparasite drugs.

### Cancer Eye

Investigations in Cattle.--Scientists at Utah State University are studying immune therapeutic agents for preventing cancer of the eye in cattle. Cancer of the eye (ocularcarinoma) is the most common neoplasma of cattle. The tumor causes considerable economic loss resulting from condemnation or reduction in the salvage value of carcasses at time of inspection in the processing plant. The investigator has developed a tissue culture model to explore the relationships and interactions between BCG cell wall vaccine and malignant cells. BCG cell wall vaccine has been shown to cause a regression of cancer in the affected animal. This study will attempt to elucidate the mechanism by which the vaccine is effective in a tissue culture system. More effective immunotherapeutic agents then may be recognized for preventing and treating cancer of the eye other malignant tumors of animals.

### Dairy Cattle

#### Mastitis

Mycoplasma Mastitis Studies.--Veterinarians at the University of California-Davis have initiated an extensive study of mycoplasma mastitis of dairy cattle. This form of mastitis spreads rapidly through a herd with serious consequences. Objectives of the research are concentrated on developing immunizing methods and effective preventive therapy and learning how the disease spreads on the farm and between farms. This epidemiologic study involves 235 herds (100,000 cows) in Tulare County and should provide information that may lead to control of the disease. Mastitis is one of the greatest economic problems facing the dairy industry and is estimated to cost the industry more than \$1 billion annually.

Population Studies of Genetic Resistance to Mastitis.--Animal scientists at the University of Wisconsin have initiated studies to determine the degree of emphasis to be placed on mastitis resistance in breeding programs. Studies thus far indicate that sire selection could effectively reduce somatic cell counts (SCC). Additional information is needed, however, before selection of dairy cattle for low cell counts can be recommended in practice. The main unanswered question is whether such selection would reduce mastitis effectively.



Mechanism of Defense against Mastitis.--Wisconsin veterinarians have initiated a basic study on the mechanism of host defense in the mammary gland. Characterization of the mononuclear cells in normal milk has shown that the ratio of B to T cells in milk is approximately 4 to 1. This is the opposite of the ratio found in peripheral blood. Studies are continuing to define the defense mechanism in the mammary gland before initiation of immunization methods for staphylococcal mastitis.

## Reproductive Diseases

### Brucellosis

Automated Complement Fixation Screening Test for Brucellosis.--Veterinary scientists at the University of California-Davis found that automated complement fixation screening test (ACFST) will detect infected animals in chronically infected herds earlier than conventional tests. The test was evaluated in both chronically and recently infected large dairy herds. From 6,000 to 9,000 specimens were examined from each herd. The brucellosis control program depends on rapid, accurate diagnostic procedures, and the ACFST seems to have value in both chronically and recently infected herds.

Indirect ELISA System for Brucellosis.--Veterinary scientists at the University of Vermont found an indirect ELISA test that is as sensitive as existing tests for the detecting of antibodies to Brucella abortus in cow's milk. It is an expensive method for screening large numbers of individual or bulk milk samples for evidence of brucellosis infection. It may have a place in the battery of tests that are used in the brucellosis control program to identify infected herds by testing the milk supply from individual herds.

### Leptospirosis

Leptospirosis - Effect on Conception Rate.--Injection of leptospira into the uterus at the time of natural mating did not lower the pregnancy rate of healthy cows. This study by veterinary scientists at the University of Minnesota was concerned with the potential transmission of leptospira by naturally infected bulls and its effect on rate of conception. Only 50 of the infected cows developed serum antibodies detectable by serological tests. The more sensitive passive protection test for hamsters, however, was positive for all inoculated cows.

Leptospirosis, sometimes referred to as "redwater," is a cause of lowered milk production, abortions, and acute systemic infections. Effective vaccines are available that will control this disease.

Rodent Control on Livestock Farms.--Scientists at the University of Arizona's Department of Veterinary Science found a significantly higher incidence of leptospirosis in trapped mice on dairy and hog farms, as compared with farms having no livestock. Studies of rodent populations on two dairy and two hog farms were compared with two farms with no livestock. These studies indicate that mice are somehow involved in the spread of this disease.

Leptospirosis attacks cattle and swine and causes acute illness, abortions, and reproductive disorders. Leptospira of animal origin may cause acute illness kidney infection in humans. This research provides strong evidence that rodent control is essential for control of leptospirosis on livestock farms.

### Parvovirus

Evaluation of Parvovirus in Reproductive Problems in Cattle.--Scientists at Clemson University have initiated studies of cows in herds with reproductive problems. Blood samples have been assayed for most common viruses and bacteria associated with reproductive dysfunction. An ELISA assay procedure developed for bovine parvovirus and antibody production was evaluated in a pregnant animal experimentally infected with parvovirus. Results of these studies indicate that parvovirus may be implicated in early embryonic death in cattle and an "immunoprotection" of the viral agent may exist in the uterine environment five months after it was eliminated from the systemic circulation. Studies are continuing to further evaluate the relationship of parvovirus and other viral agents to reproductive dysfunction.

### Placenta Retention

Supplemental Selenium and Vitamins A, D, and E on Parturient Disorders.--Veterinarians and animal scientists at the University of Nebraska have found that supplemental selenium and vitamins A, D, and E had no beneficial effect in reducing the incidence of placental retention and other disorders following parturition in cows receiving an adequate diet. These investigators cautioned that indiscriminate use of these treatments should be avoided because of an unexplained higher incidence of ulcerative foot disease as seen in the group receiving combined treatments of selenium and vitamins A, D, and E. This cooperative effort has provided practical information to the cattle industry on limitations of the supplemental use of selenium and vitamins A, D, and E. Selenium and vitamin E are important dietary ingredients in preventing white muscle disease in calves and lambs, but high levels may be toxic.

### Pyometra

Studies on the Treatment of Pyometra.--Scientists at the University of New Hampshire have undertaken a study to determine if certain hormones are effective agents in the treatment of induced bovine pyometra. A tissue culture system has been developed that uses endometrial tissue for the source of epithelial cells. This tissue culture system is treated with a hormone such as estradiol 17-B; the cells are exposed with a suspension of Streptococcus pyogenes; and, finally, scanning electron microscopy is used to determine the degree of bacterial adherence to the endometrial cells. This system may provide a unique way to study various treatments of pyometra, a cause of infertility in cattle.



## Estrus Detection

New Methods of Detection of Estrus.--Veterinary scientists at Texas A&M University have a basic research program underway on reproductive diseases of cattle, including hormonal effects in such diseases. Their research has led to findings that could produce a rapid, simple test for heat detection. They have identified the sensory system that bulls use to detect heat. It is an auxiliary olfactory system, located just above the roof of the mouth. By use of time-lapse photography, veterinary scientists have been studying the behavioral patterns of bulls during the heat cycle of the female and have developed a behavioral assay system for evaluating urine samples for the presence of estrous pheromone. Studies will continue on the isolation, purification, and identification of bovine estrous pheromone.

Because of certain management systems, cattle in heat may not be observed and the detection of heat is highly important to improve the reproductive capacity of the dairy and beef cattle herds.

## Infertility

Studies on Infertility Show Promise.--Scientists of the College of Veterinary Medicine and the College of Agriculture at Texas A&M University have concentrated their efforts on two different types of technology for use in diagnosing the causes of infertility in cattle. Embryo collection techniques, used in embryo transfer, have been shown to be effective for distinguishing between cows that are capable of producing fertilized ova and those that are not.

Laparoscopy techniques, used extensively for diagnosis of human infertility, have been used to diagnose ovarian and oviduct abnormalities in infertile cattle. Work is also underway to evaluate detailed patterns of pituitary hormone (LH) release for use in diagnosis of cattle infertility. Reproductive diseases cost the cattle industry a billion dollar loss each year because of less than optimum calf crop.

## Digestive-Enteric Diseases

Calf and Pig Scours - Life-saving Treatment Developed.--Research workers at Colorado State University's College of Veterinary Medicine and Biomedical Sciences have developed a practical treatment procedure for young calves and pigs suffering from bacterial enteric disease (scours) and septicemia. Scours caused by endotoxins, which are produced by pathogenic E. coli is responsible for serious losses in young calves and piglets. Colorado State University studies indicate that these endotoxins in turn produce metabolic changes in the animals, particularly in sugar metabolism. The life-saving treatment development at Colorado will allow time for calves and piglets to develop immunity to bacteria that produce endotoxins. Calf scours costs the cattle industry about \$250 million annually and causes the death of one of every four calves.

Calf Enteric Diseases - Research in Identifying Various Agents.--The scientists at Ohio Agricultural Research and Development Center have concentrated

their research on identifying various agents associated with enteric infections of young calves. Different strains of rotavirus have been identified and studied in germ-free, colostrum-deprived calves and conventional calves. These studies are highly important if effective immunizing agents are to be developed.

Information was used to develop a specific project on rotavirus that is supported by an animal health special grant. The electrophoretic analysis of rotaviral DNA has revealed that the different strains of rotavirus do have slightly different genomes and that a shift can occur in a closed herd.

The ELISA techniques also were found highly valuable in the study of rotavirus infections. Research indicates that successful rotaviral vaccines may need to be tailored to counter specific strains of this virus.

Winter Dysentery - Study Underway in Connecticut.--Winter dysentery is a common problem in stabled cattle, and in lactating cattle causes a sharp fall in milk production, dehydration, and loss of weight and condition. Several experiment stations are investigating this disease. Scientists at the University of Connecticut have initiated a study of natural and experimentally produced infections. Although the consistent agent isolated is Campylobacter spp. (Vibro), consistently reproducing the disease with Campylobacter spp. has been extremely difficult. Studies are continuing with 12 infected herds in New England. Gas chromatography is being used to explore the possibility that diagnostically significant specific bacterial byproducts may be detectable in sera and other fluids.

Salmonellosis - Study to Develop Control Program.--Cattle marketed through a large stockyard show little salmonella infection while slaughtered boars show a high rate of infection, according to findings in the first year of the University of Minnesota's study of salmonella infections in cattle and swine during transport and marketing. The purpose of this study is to develop control programs for salmonellosis. Salmonellas are associated with intestinal infections in animals and cause food poisoning when humans consume infected meat from animals or poultry.

Bovine Neonatal Diarrhea - Research Project on Bovine Neonatal Diarrhea.--Scientists at the University of Maine have developed a research project on bovine neonatal diarrhea to determine the role of various viral and bacterial agents in the etiology of this disease. Preliminary results indicated that pathogenic E. coli and corona viruses were encountered most frequently, with much lower incidence of rotavirus and no detection of salmonellas. The research indicated a direct relationship between the mean coliform count and enteropathogenicity of the E. coli isolates. High coliform counts were related significantly to enteropathogenicity of the strain. This information may help in the diagnosis of neonatal calf diarrhea due to E. coli.

Calf Enteritis-Pneumonia - Multidiscipline Approaches.--Scientists in veterinary medicine and animal science at Washington State University have initiated interrelated studies on the calf enteritis-pneumonia problem. Objectives of this study are to determine the relation of nutrition before calving on incidence of calf scours, the role of enteropathogens (E. coli

viruses) in the disease complex, how transportation and thermal stressors alter the humoral and cellular immune system and to develop a method to detect and quantitate endotoxin levels that will provide a clinical basis for preventing and treating the disease. These studies will help in developing recommendations that will control and prevent calf enteritis-pneumonia. The loss from calf scours and pneumonia is one of the most serious problems facing the dairy and beef cattle industries.

Abomasal Displacement - Cause and Prevention Studied.--Pennsylvania scientists are studying the cause and prevention of abomasal displacement (AD) in cattle, which is encountered in high-producing, heavily fed dairy cattle, usually near parturition. Studies did not confirm previous views on the pathogenesis of abomasal displacement. Scientists at the University of Pennsylvania's School of Veterinary Medicine used 29 cows with AD that had been corrected non-surgically. Two types of diets used were with corn silage and grain and with grass, hay, and grain. Abomasal displacement reoccurred equally in both groups. One theory for the development of AD is the increase of volatile fatty acid in the rumen and abomasum. This increase decreases abomasal motility, predisposing the animal to AD. In the experimental cows, rumen volatile fatty acids decreased, rather than increased, before abomasal displacement.

Additional studies were initiated to investigate the effects of hypocalcemia and metabolic alkalosis on abomasal motility. Both these conditions have been associated with the development of AD. Techniques were used to measure rumen and abomasal motility. Hypocalcemia and alkalosis did not significantly reduce abomasal motility. Findings from these studies indicated that these two factors are probably of minor importance in the development of AD or at least as primary factors influencing abomasal motility. Studies are continuing to evaluate other factors that may cause AD.

### Metabolic Diseases

Parturient Hypocalcemia.--Veterinarians at Ohio State University at Columbus have initiated a basic study on the prevention of parturient hypocalcemia (milk fever) by the active metabolite of vitamin D<sub>3</sub>. "Milk fever," a common problem in high-producing dairy cows, occurs soon after calving and causes circulatory collapse, generalized paralysis, and depression of consciousness. Three active metabolites of vitamin D<sub>3</sub> were evaluated in nonpregnant, non-lactating dairy cows. The metabolite 1,25 (OH)<sub>2</sub> D<sub>3</sub> caused a more rapid and greater increase in serum calcium and phosphorus than similar doses of 1 α-(OH) D<sub>3</sub> 24R, 25-(OH)<sub>2</sub> D<sub>3</sub>. It appeared to increase bone resorption in addition to stimulating intestinal calcium transport in adult cows. These actions from vitamin D<sub>3</sub> medication should have beneficial effects in preventing "milk fever."

Various prophylactic regimes including high doses of vitamin D before calving have been used for "milk fever," but they have limitations because of danger of toxicity and severe reaction. The studies at Ohio State will continue to evaluate the active metabolite 1,25-(OH)<sub>2</sub> D<sub>3</sub> in developing effective doses for pregnant cattle.

Downer Cow Syndrome.--Minnesota scientists now have established that pressure damage to muscle and nerves occurring in prolonged recumbency results in cows "going down" after calving. These cows are unable to stand but otherwise often



appear normal. Since the animal is unfit for commercial slaughter, losses are substantial exceeding \$200 million a year. With the precise cause now identified, studies have been initiated on management, nursing, and treatment methods that will prevent the downer cow syndrome from occurring. Nursing procedures have been devised that seem particularly promising. Further studies will clarify the value of these methods and others.

### Congenital Defects

Congenital Defect in Jersey Cattle Under Study.--Veterinarians at Kansas State University have initiated a study of rectovaginal constriction (RVC), a congenital defect of female and male Jersey cattle. This defect leads to difficulty in parturition. Secondary involvement of the udder resulting in edema and mastitis, may cause loss of quarters. The defect appears to stem from homozygosity of a simple autosomal recessive genes. This study has been a cooperative effort with veterinary practitioners or cattle breeders in 20 States. A total of 38 RVC-affected cattle were transported to Kansas State University for these studies. This study will help cattle breeders to eliminate this genetic defect.

### Swine

#### Pseudorabies

Vaccine against Pseudorabies.--Michigan State University veterinarians have perfected a vaccine for pseudorabies that is superior to live modified and inactivated vaccines. This subunit vaccine was used in young pigs that were challenged with a virulent strain of pseudorabies virus. The vaccinated pigs did not shed virulent virus, but pigs vaccinated with the commercially available vaccines either live, modified, or inactivated when challenged shed virulent virus up to eight days. The experimental vaccine produced higher serum antibody response than the commercial vaccines. This work will be expanded, and the vaccine will be used under field conditions.

Vaccine Trials for Pseudorabies.--An experimental vaccine developed by scientists at North Carolina State University's School of Veterinary Medicine has given encouraging results in protecting pigs against pseudorabies. In addition, it does not interfere with the blood test used to detect pigs infected with this disease.

Experimentally infected vaccinated pigs do not become carriers. The veterinary scientists have been working with nonporcine herpes viruses and administering them through the nose. Four weeks are required to produce maximum protection. How long immunity lasts beyond four weeks is now being studied. Research workers are encouraged with results and will continue their research along these lines.

### Enteric Diseases

Swine Dysentery - Carrier Status Under Study.--Auburn University have shown that swine infected experimentally and naturally with swine dysentery (Treponema hyodysenteriae) shed the bacteria daily for 3 to 6 weeks after infection. Intermittent shedding of T. hyodysenteriae has been shown to occur for periods up to 6 months after clinical disease has occurred. Methods are being developed to improve detection and recovery of T. hyodysenteriae where low numbers of organisms are being passed in the feces of carrier pigs. Immune mechanisms responsible for resistance are being evaluated. Preliminary evidence indicates that cell mediated immunity may play a role in recovery from the disease.

E. coli -- Drugs for Control of Swine Enteritis.--Iowa State University scientists have initiated a basic study to determine the effects of E. coli enterotoxins on swine mucosal epithelium of the intestinal tract and ability of selected drugs to modify the secretory function. Enteric disorders caused by E. coli in the young pig are encountered commonly. The understanding of diarrhea mechanisms should provide the bases for more effective preventive and treatment measures.

Drugs affecting intestinal epithelial transport were investigated, and certain drugs (opiates) have a major function in the control of transport across the intestinal mucosa. This could lead to significant, far-reaching improvement in diarrhea control, treatments, and improved nutrient absorption.

Resistance Mechanism.--Scientists at the College of Veterinary Medicine, Oklahoma State University, have underway basic studies to determine the role of the intestinal epithelial cell's glycoprotein coating in its reaction to pathogenic E. coli. E. coli, the common cause of scours of young pigs, may cause high mortality. The chemical composition of the glycoprotein (glycocalx) will be determined during various stages of development of the epithelial cell. Efforts also will be made to relate the stage of glycocalx development to intestinal infection. Pathogenic E. coli releases a toxin or poison that injures the intestinal cells when the cells are bound to the intestinal wall. This study will provide information on physiopathologic changes at the cellular level and how these adverse changes may be altered to provide beneficial protection against pathogenic E. coli.

Diagnosis of Enteric Infections in Pigs.--This project has been involved in the development of modern methods for the diagnosis of enteric viral diseases of pigs. Scientists at the Ohio Agricultural Research and Development Center have concentrated their efforts on rotavirus, rotavirus-like agents, and TGE virus. A cell culture-immunofluorescent test has been developed that is a relatively simple and rapid method for demonstrating rotaviruses from fecal samples, rectal swabs, and intestinal contents. Other previously undescribed viruses have been identified, and their significance as enteric pathogens is under study. This project is essential in the development of modern diagnostic aids for veterinary diagnostic laboratories.

### Lameness

Reducing Lameness in Fast-growing Young Boars.--A study to find ways of reducing lameness in young boars is underway in a cooperative research project among veterinary scientists at the University of Minnesota and Purdue

University. Osteochondrosis, the major cause of lameness, is a problem in the maturation of cartilage, particularly with the fast-growing long bones of the animal's limbs. This bone disturbance is seen in fast-growing animals such as pigs, chickens, turkeys, horses, and dogs. Findings from this research should be helpful in identifying the cause and prevention of this disease in pigs and other animals.

### Mycotoxins

Procedure Developed to Analyze Tissues for T-2 Mycotoxins.--Veterinary toxicologists at the University of Illinois have developed a procedure to analyze swine and cattle tissue and fluids for T-2 toxins (mycotoxin) and a T-2 toxin metabolite. Half-life of T-2 toxin in the plasma was less than 5 minutes and a T-2 toxin metabolite was detected in body fluids and tissues for a longer period of time. Swine and calves dosed intravenously developed signs of repeated vomiting, unsteadiness, abdominal straining, and reduced production of urine. Some of the swine died. Degenerative changes were observed in lymphoid tissue (immune systems) and cardiac muscle.

### Iron Treatment

Enhancement of Iron Placenta Transport.--Scientists at South Dakota State University have underway extensive basic studies that evaluate various iron ionophore compounds and cofactors that enhance the intestinal absorption and placental transport of iron when added to sow gestation rations. Nutritional anemia is a major physiologic problem with young piglets. Currently, individual piglets 1 to 3 days old must be injected with iron dextran. The results are encouraging. If field studies support the laboratory studies, injecting millions of young pigs with iron dextran can be reduced or eliminated. In 1979 over 100 million pigs were born, and a high percentage received individual iron dextran treatment.

### Ear Necrosis

Incidence on the Increase.--Research workers at Purdue University's School of Veterinary Medicine have isolated an organism (Staphylococcus hyicus) from the lesions of several outbreaks of ear necrosis in swine herds in Indiana. This disease, a common sporadic problem, appears to be increasing. The morbidity varies from 5 to 90 percent. Studies are continuing to develop methods of controlling the disease. No correlation with various management conditions has been identified.

### Agalactia

Role of E. coli Endotoxin.--Veterinary scientists at the University of Illinois have been involved in research on agalactia in swine for several years. They recently initiated a study on the effect of E. coli endotoxin on the secretion of prolactin, which stimulates letdown of milk. Introduction of prolactin secretion by single injections of E. coli endotoxin significantly decreased the rate of growth in piglets. The ability of endotoxin to suppress prolactin secretion and, therefore, lactation indicates that mild infections with some E. coli strains could provide sufficient endotoxin to interfere with prolactin secretion and depress lactation.



Agalactia is an important cause of death in piglets. The estimated losses from milk production deficiencies are greater than \$100 million a year for the swine industry.

## Poultry

### Respiratory Diseases

Avian Influenza - Polyvalent Vaccine Effective in Turkeys.--An inactivated vaccine for avian influenza in turkeys has reduced virus shedding and airsacculitis and has given protection against drop in egg production. Scientists at the University of Minnesota's College of Veterinary Medicine have used the vaccine in millions of turkeys in high-risk areas to prevent avian influenza in turkey breeders and market turkeys. In 1978-79, the disease caused a \$5 million loss for the turkey industry in Minnesota alone. The losses in Minnesota have been as high as 41 percent in breeder flocks and 76 percent in market flocks. Avian influenza affects not only turkeys but also other domestic fowl, such as chickens, ducks, geese, and pheasants, and wild water fowl. Highly virulent strains, identified as fowl plague, may cause losses as high as 100 in a few days. The U.S. has not experienced fowl plague since 1929. In 1979, however, an outbreak occurred in England and in 1975, in Australia.

### Turkey Coryza

Causative Agent of Alcaligenes Rhinotracheitis in Turkeys.--The causative agent for turkey coryza has been identified by research workers at North Carolina State University's School of Veterinary Medicine. Respiratory infection, such as turkey coryza, in turkeys and chickens, has top priority for research according to the poultry industry. Scientists have been able to reproduce this disease and are now studying ways to develop managerial techniques and immunizing agents to control it. Under field conditions, high mortality is associated with secondary bacterial or viral infections and poor management practices. This disease has been identified in practically all turkey-raising areas of our country.

### Fowl Cholera

Vaccination Methods.--Fowl cholera remains an important disease problem in turkeys and chickens. Research workers at the University of Missouri's College Veterinary Medicine have evaluated various routes of administration of (Clemson University) cholera vaccine strain and the effects of physiologic status on development of immunity.

Disease resistance was greater in young turkeys vaccinated with CU vaccine strain when the vaccine was administered by the wing-web puncture method or in the drinking water than when given under the skin. Both sexually mature male and female turkeys were more susceptible to vaccination reaction and disease than young turkeys. These results emphasize the importance of using the CU vaccine at 6 to 8 weeks of age and repeating the vaccine at these intervals until the birds reach sexual maturity. Fowl cholera costs the turkey industry a \$15 million loss annually. Research on this disease has high priority from the turkey industry.

Clemson University scientists have continued their studies on serum protein changes in response to the CU fowl cholera vaccine in turkeys to identify markers demonstrating the degree of immunity. At the present time, challenge tests are the only means of demonstrating degree and duration of immunity following vaccination. The total serum protein levels and serum antibody titers were compared with challenge tests, and the results gave poor correlation between antibody titers and immunity.

Other tests to determine the degree of immunity are being studied. The CU strain widely used as a vaccine for turkeys is now being used to vaccinate chickens.

### Colibacillosis

Vaccine Reduce Losses in Turkeys.--New vaccines developed by scientists at the University of Minnesota's College of Veterinary Medicine reduced turkey losses from colibacillosis, commonly a secondary infection in respiratory diseases turkeys and chickens. The disease costs the turkey industry an estimated \$25 million a year. Infection from colibacillosis is an important cause of poultry carcass condemnation. Inactivated and attenuated vaccines of *E. coli* 078 have been used successfully in young turkeys. In addition, scientists have developed a new sensitive diagnostic test.

### Newcastle Disease

Migrating Waterfowl Serves as Reservoir.--Wisconsin scientists have shown that a respiratory-reproductive problem in turkeys is caused partly by Newcastle disease virus (NDV) that has a reservoir in migratory waterfowl. Studies performed on 65 NDV isolates from waterfowl and isolates from turkeys indicated that isolates had similar properties and were distinguishable from vaccine strains. In some turkey-raising areas, these mild strains are involved in complicated respiratory infections in market birds, resulting in high condemnations at the time of processing and interruption of egg production in laying flocks. Studies are continuing to evaluate measures for preventing this disease.

### Enteric Diseases

#### Salmonellosis

Control by Competitive Exclusion.--Veterinarians at the University of Massachusetts have continued to study the effect of competitive exclusion of salmonellas and pathogenic *E. coli* by the protective microflora of the avian intestinal tract. These studies have demonstrated that infection by *S. gallinarum*, the causative agent of fowl typhoid, was inhibited measurably by the protective flora. The degree of protection was not sufficient, however, to be of practical significance for the control of infection.



Fowl typhoid has been nearly eradicated from the U.S., but this disease is widespread in Mexico, Central America, and South America and threatens the poultry industry of the United States. These studies indicate that the technique of competitive exclusion has value in the development of control programs for salmonellas in chickens and turkeys. Studies are continuing to identify the specific intestinal bacteria involved in competitive exclusion. At the current time, this procedure has limited field application because it entails the exposure of young chicks to intestinal contents of adult chickens.

Botulism - Controlled in Broiler Flocks.--Scientists at the School of Veterinary Medicine, University of Pennsylvania have been studying the factors involved in field outbreaks of botulism on a commercial broiler farm where the disease persisted for several years. Several measures were tried, including the use of botulism toxoid at day of age, prophylactic administration of selenium or acetic acid in the drinking water, and control of infestation of the buildings with darkling beetles. These measures helped reduce mortality. Control of botulism in broiler houses was obtained by good management practices that included a cleaning and disinfecting program between each flock, control of darkling beetle with Seven or Rabon, pretreatment of the floor with sodium bisulfate, use of new litter with good litter management control, and prompt removal of dead birds. Botulism has been reported recently in several broiler-raising States.

#### Genetic Resistance to Disease

Blood Typing may be a Tool to Improve Genetic Resistance to Disease in Chickens.--Scientists at the University of Arkansas are involved in a long-term study to determine the genetically related specific immune mechanisms in chickens. Rous sarcomas were used as the experimental infection, and several parameters at various stages of regression and progression of Rous sarcomas were measured among chickens of different lines.

The commercial poultry industry no longer uses blood typing as a tool to improve economic traits. Research now indicates that blood typing may be valuable to improve genetic resistance to disease. This technique may help identify strains of chickens resistant to such diseases as lymphoid leucosis, Marek's disease, and salmonellosis that are not controlled by vaccination procedures or management programs.

#### Sheep and Goats

##### Reproductive Diseases

Chlamydial Infection - Relationship to Infertility.--Veterinary scientists at Auburn University have developed a model in the goat to study the effect of chlamydial-induced infection of the testes on semen maturation. Chlamydial infections in bulls and rams sometimes result in infertility and reproductive failures and in abortions in cattle and sheep.

Investigators by surgically cannulating the rete testes in experimentally infected goats, have been able to isolate the organism from semen and rete testes fluids. Studies are continuing to further characterize the shedding of Chlamydia from the infected animals and the serologic response. This research will help to clarify the role of Chlamydia in infertility problems and reproductive failures in sheep, cattle, and goats.

### Epididymitis

Brucella ovis Bacterin - Effective in Reducing the Incidence of Disease of Rams.--Veterinarians at Montana State University have evaluated an experimental bacterin and found it effective in reducing the incidence of epididymitis of rams caused by Brucella ovis, but other types of nonbrucella epididymitis were not controlled. The Brucella ovis organism is associated with infertility in rams and abortion and reproductive problems in ewes. Several organisms have been isolated from rams with epididymitis and are being studied in normal rams. So far, only Brucella and Chlamydia have induced epididymitis. These studies will be helpful in developing flock programs to eliminate this disease.

### Infertility

Transmission of Actinobacillosis in Rams Under Study--Veterinarians at Kansas State University are studying the reproductive tract of rams infected with a bacterium, Actinobacillus seminis. Results of experimental infections indicated that A. seminis may infect part or all of the reproductive tract of rams. Research workers found that immunofluorescence techniques (IF) were effective in making a rapid and accurate diagnosis of this problem in sheep. In young lambs the organism localizes in the lungs, and some infected lambs may become carriers and perpetuate the infection in the reproductive tract. This research clarifies causes of reproductive infections in sheep. Reproductive diseases cause a \$50 million annual loss to the sheep industry.

### Brucellosis

Improved Diagnostic Techniques in Goats--Veterinarians at Virginia - Maryland Regional Veterinary College are studying immune mechanisms of brucellosis in goats as a model for the disease in cattle. Brucella melitensis, a more common strain found in goats, is being used as type organism. The objective of this study is to develop procedures that will distinguish Brucella-vaccinated ruminants from field strain-infected ruminants. Capability for such differentiation is important to eventually eradicate brucellosis since vaccinated and naturally infected cattle may react similarly to tests for the disease.

### Bluetongue

Vaccine in Sheep is Effective--Scientists at the Texas A&M University have developed a multivalent bluetongue vaccine for sheep that appears to be safe and effective under laboratory and field conditions. This vaccine provides protection against four strains of bluetongue virus occurring in the United States.

Bluetongue a disease of sheep, cattle, goats and wild ruminants, causes serious losses in sheep in the Southwest. It is a milder disease in cattle, and is transmitted by gnats. Because this disease is present in sheep, cattle, and goats in the U.S., the export market of breeding animals has been limited.

### Caseous Lymphadenitis

Studies Initiated at University of Wyoming.--Scientists at the University of Wyoming have initiated a study on caseous lymphadenitis in sheep. This infection is widespread in flocks in western range States and increases deaths and condemnations of carcasses upon slaughter. Objectives of this study are to determine the morbidity and incidence of this disease and the effect of internal parasites upon its course. In addition, the role of immunity will be determined in developing methods to control and prevent caseous lymphadenitis. Various serological tests will be evaluated to improve the diagnostic capabilities. These tests will be helpful in developing programs to reduce losses.

### Endotoxic Shock

Endotoxic Shock and Pregnancy Toxemia in Sheep.--Scientists at the University Pennsylvania's School of Veterinary Medicine have initiated basic studies on endotoxic shock in sheep. Endotoxin causes several metabolic abnormalities, mainly low blood glucose and lactic acidosis. The degree of lactic acidosis associated with the degree of depression and death. Studies to develop treatments to correct lactic acidosis are underway.

### Mycotoxicosis

Mycotoxicosis from Pasture Grasses and Forbes Highly Lethal to Sheep.--Toxic fungi were identified on pasture grasses and forbes that caused the death or severely affected all of the sheep on a ranch in west Texas. The Texas A&M University scientists identified five types of potentially toxic fungi among 54 fungi growing on pasture grasses and forbes on a large range in this area. The fungus, Phomopsis leptostromiformis, which is known for its frequent cause of severe liver disease in domestic animals, was found. A severe liver disease in calves eating moldy grass hay was reproduced by feeding calves hay that was stored for 2 years. Research is continuing to develop methods of control.

## Equine

### Equine Infectious Anemia

Transmission Studies.--Scientists at Louisiana State University's School of Veterinary Medicine, in cooperation with personnel at Nicholls State University, are evaluating the disease risk factors associated with maintaining reproductively active bands of horses that are infected with equine infectious anemia (EIA) virus but show no signs of the disease. Horse owners and animal disease regulatory agencies need this information to make informed decisions on the disposition of the EIA-virus-infected (swamp fever) horses.

For example, foals from EIA-virus-infected mare are less likely to acquire infection than adult sentinel horses. Experiments are being designed to determine whether these foals are resistant to infection because of their colostral immunity or whether they are less attractive to the blood-feeding insect vectors of EIA virus. This field study on the transmission of EIA virus is the only one of its kind in the United States, and the data generated are of major importance to owners of horses.

### Respiratory Diseases

Vaccine for Equine Influenza.--Experimental horses inoculated with temperature-sensitive (TS) virus (A<sub>1</sub>) have shown immunity against "wild type" equine influenza virus in research at Cornell University. The TS virus (A<sub>1</sub>) was able to grow in the upper respiratory tracts of the inoculated horses, but it did not produce fever or other signs of illness. Scientists at Cornell's New York College of Veterinary Medicine are planning to do further testing in experimental horses. Additionally, TS equine A<sub>2</sub> influenza virus will be generated and tested in experimental horses.

Equine influenza may cause severe reactions in susceptible horses that may require 6 months to recover from the infection. This disease may be complicated by bacterial infections, chronic bronchitis, asthmoid conditions, and pulmonary emphysema.

### Reproductive Diseases

Effect of Ovarian Hormones on the Resistance of the Uterus to Infection.--Veterinarians at Auburn University have been studying the interrelationship between ovarian hormones and uterine infections in mares. Their studies showed that resistance of the equine uterus to bacterial infection is related to hormonal changes in the mare. Experiments involved the use of an organism, Streptococcus zooepidemicus, commonly encountered in uterine infections. Eighteen ovariectomized mares were used in the study with a control group. Mares under the influence of progesterone remained infected throughout the experiment as compared with control and estrogen-treated group. Estrogen priming significantly increased in phagocytosis. This study has been helpful to the clinician in the treatment of uterine infection in the mare.

### Parasitism

Eyeworm Infection in Horses.--Parasitologists at the University of Kentucky are continuing their research of eyeworms in horses. A total of 29 pony foals were experimentally infected with Thelazia lacrymalis. This parasite requires 67 to 77 days to reach maturity after the animals are exposed to infective larvae, derived from face flies artificially infected. A study of natural infections in 202 horses from central Kentucky revealed an infection rate of 30. The highest prevalence of infection was in 1-to-3-year-olds. Studies will continue to develop effective control measures.



### Aquaculture

Immunization of Fish Against ICH.--A vaccine to immunize fish against lethal infection from a parasite, ICH, has been developed by scientists at the University of Georgia's College of Veterinary Medicine. While this vaccine has only been used experimentally, it shows possibilities of being developed into a useful field procedure. The parasite, ICH, is a severe problem in aquaculture and also causes epidemics in natural waters, particularly in culture fish. Losses to ICH are estimated at \$1 million a year. Scientists used antigens from a cultivable protozoa to protect the fish.

Research on Diseases and Parasites.--Scientists at the University of Rhode Island have initiated a study of diseases and parasites of fish and selected native species of mollusca. This study also will help determine the role of feral fishes in the spread of diseases to cultured salmonids and other fishes. Intensive food-fish culture is expanding in the U.S. and other countries, and as in any intensified food animal production system, hazards from diseases and parasites increase. In 1978 the 100,000 metric tons of freshwater fish and fish products reared in the U.S. had a farm value of over \$300 million.











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